

THE ANALYST.

DECEMBER, 1901.

PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

THE monthly meeting of the Society was held on Wednesday evening, November 6, in the Chemical Society's Rooms, Burlington House.

The President (Dr. J. AUGUSTUS VOELCKER, M.A., B.Sc.) occupied the chair.

The minutes of the previous meeting were read and confirmed.

Certificates of proposal for election to membership in favour of the following candidates were read for the first time: Mr. Horatio Ballantyne, F.I.C., Analytical and Consulting Chemist, 75, Chancery Lane, W.C.; Mr. M. Hunter, M.A. (Oxon.), Science Lecturer, Rangoon College; Mr. Ernest Alfred Lewis, Assayer and Metallurgist to Muntz's Metal Co., Ltd., French Walls, near Birmingham; Mr. Frederick J. Lloyd, F.I.C., Analytical and Consulting Chemist, Muscovy House, Trinity Square, E.C.; Mr. Albert E. Parkes, F.I.C., Analyst to the Stepney Borough Council, 43, Whitehorse Street, Stepney, E.; and Mr. Thomas Tickle, B.Sc. (London), Public Analyst for the City of Exeter, 4, Hills Court, Exeter.

Mr. F. M. Wharton, F.I.C., was elected a member of the Society.

The following papers were read: "The Composition of Milk," by H. Droop Richmond; "The Determination of Carbon in Steel by Direct Combustion," by Bertram Blount; and "*Enteritidis sporogenes* as Evidence of Sewage Pollution," by M. Dechan.

The PRESIDENT (Dr. Voelcker) said that the Council had been requested to lay before the Departmental Committee on Butter Regulations appointed by the Board of Agriculture the views of the Society on the question of the composition of butter, the point dealt with by the Departmental Committee in the first instance being that of the maximum proportion of water that butter should contain. With the view of eliciting the opinions of members and putting forward an authoritative view on the question, there were circulated among the members of the Society forms of inquiry, the replies to which were collected and considered by a committee appointed by the Council for the purpose. These replies formed the basis of the conclusions which Dr. Dyer and Mr. Hehner, as the representatives of the Society, laid before the Departmental Committee in the course of their evidence. It was intended that the work of the Departmental Committee should include the consideration of questions relating not only to the proportion of water in butter, but also to the general nature and composition of butter, and this matter would form the subject of investigation and consideration by the committee appointed by the Society's Council, and of further evidence by their representatives.

Dr. DYER said that over ninety members of the Society had communicated their views on the question of water in butter. Of these a majority were of opinion that 16 per cent. should be fixed as a limit, and of the remainder a large preponderance were in favour of a lower limit, namely, 15 per cent., while some few recommended even lower limits still. Only a very few were in favour of a higher limit than 16 per cent. The committee appointed by the Council of the Society, having carefully weighed all this evidence, considered that it would on the whole express well the feeling of the Society if Mr. Hehner and himself were instructed to lay before the Departmental Committee, as the view prevailing in the Society, that the proportion of water permissible in butter should be fixed at 16 per cent., and a recommendation to that effect was accordingly made by them; but at the same time the diverse views of the minority of the members were also laid before the Committee. They were accorded a long and patient hearing, and underwent a long cross-examination on the subjects mentioned in the course of their evidence. He believed it was expected that the Departmental Committee would formulate some recommendation on the subject of water in butter in an interim report, without waiting until it had heard evidence on the much more difficult and knotty subject of the standards which should be fixed as indicative of genuine composition in the case of butter-fat.

THE COMPOSITION OF MILK.

BY H. DROOP RICHMOND, F.I.C.

(Read at the Meeting, November 6, 1901.)

Mean Composition during 1900.—Of the 34,978 samples examined in the Aylesbury Dairy Company's Laboratory during 1900, 29,482 were samples of milk. The composition of 13,798 received from the farms is given in Table I.

TABLE I.

Average Composition of Milk during 1900.

Month.	Morning Milk.				Evening Milk.				Average.			
	Specific Gravity.	Total Solids.	Fat.	Solids-not-fat.	Specific Gravity.	Total Solids.	Fat.	Solids-not-fat.	Specific Gravity.	Total Solids.	Fat.	Solids-not-fat.
January ...	1·0326	12·48	3·49	8·99	1·0325	12·83	3·80	9·03	1·0326	12·66	3·65	9·01
February...	1·0325	12·45	3·48	8·97	1·0324	12·79	3·78	9·01	1·0325	12·62	3·63	8·99
March ...	1·0326	12·40	3·43	8·97	1·0325	12·77	3·76	9·01	1·0326	12·58	3·59	8·99
April ...	1·0324	12·33	3·40	8·93	1·0323	12·70	3·75	8·95	1·0324	12·52	3·59	8·93
May ...	1·0327	12·23	3·26	8·97	1·0325	12·66	3·67	8·99	1·0326	12·44	3·46	8·98
June ...	1·0326	12·21	3·27	8·94	1·0322	12·61	3·69	8·92	1·0324	12·41	3·48	8·93
July ...	1·0320	12·26	3·44	8·82	1·0314	12·43	3·69	8·74	1·0317	12·34	3·56	8·78
August ...	1·0318	12·26	3·47	8·79	1·0314	12·60	3·86	8·74	1·0316	12·43	3·66	8·77
September	1·0321	12·39	3·51	8·88	1·0317	12·70	3·88	8·82	1·0319	12·54	3·69	8·85
October ...	1·0323	12·56	3·62	8·94	1·0321	12·86	3·92	8·94	1·0322	12·71	3·77	8·94
November	1·0326	12·72	3·69	9·03	1·0323	12·98	3·98	9·00	1·0324	12·85	3·84	9·01
December	1·0327	12·63	3·61	9·02	1·0324	12·90	3·88	9·02	1·0325	12·76	3·74	9·02
Average ...	1·0324	12·41	3·47	8·94	1·0321	12·74	3·81	8·93	1·0323	12·57	3·64	8·93

The morning and evening milks have been kept separate. As has been observed in former years, the lowest fat occurs in May and June, and the highest during October and November. During July and August, as has been invariably the case in previous years, the solids-not-fat are lower than in the other months, and these begin to rise during September, and become normal towards the end of the month.

Accuracy of Methods Used.—As in the bulk of the analyses the fat is determined by the Gerber method and the solids-not-fat calculated, I have compared the results with those obtained by the Adams method for fat and the asbestos method for total solids.

In 78 analyses the difference between Adams and Gerber was :

In 69 cases, or 88·5 per cent.,	0·1 or less ;
„ 8 „ 10·2 „	0·1 to 0·15 ; and
„ 1 case, or 1·3 „	above 0·15.

The mean figures were identical.

In 82 analyses the difference between the fat calculated and that found was :

In 60 cases, or 73·2 per cent.,	0·1 or less ;
„ 19 „ 23·2 „	0·1 to 0·15 ; and
„ 3 „ 3·6 „	0·15 to 0·2.

The mean calculated fat was 0·019 per cent. less than the mean fat found.

It is evident that the figures in Table I. are close approximations to the truth.

Some experiments were made with Macfarlane's chrysotile method (ANALYST, xviii., 73). On shaking up a little chrysotile with water, it was found that the water was very distinctly alkaline to phenolphthalein, and it was thought that the lower results formerly obtained (ANALYST, xix., 77) might be due to heating the milk in the presence of soluble alkaline salts. A quantity of chrysotile was treated with strong hydrochloric acid, washed till neutral, and dried ; a quantity of asbestos was similarly treated.

The results on one sample of milk were :

Dried on washed asbestos ...	12·70 per cent. total solids.
„ unwashed asbestos ...	12·70 „ „
„ washed chrysotile ...	12·47 „ „
„ unwashed chrysotile ...	12·34 „ „

It was evident from these figures that the lower results are not wholly due, though perhaps partially, to the presence of alkaline salts.

The fat was estimated by extracting the dried solids with ether, with the following results :

Extracted from washed chrysotile ...	3·65 per cent.
„ unwashed chrysotile ...	3·62 „
Adams's method ...	3·65 „

The slightly lower result from unwashed chrysotile suggests that a small portion of the fat was saponified by the alkali ; as the method, even after the very tedious process of completely washing the chrysotile was adopted, failed to give results of a satisfactory nature, it was not further investigated.

Variation in Fat during Delivery of the Milk.—The same average percentage of fat (3·64) was found in 7,359 samples taken before delivery and in 4,543 samples

taken during delivery, though the variations were somewhat wider in the latter series than in the former, due to the tendency that cream has to separate from milk on standing. I have been asked what may be considered an extreme reasonable limit of variation, and the two series afford data for deducing this. I consider that the following formula gives a figure which is as correct as possible :

$$\text{Limit of variation} = 2.022 \sqrt{\frac{\Sigma^2_{\text{I}}}{n_{\text{I}} - 1} - \frac{\Sigma^2_{\text{II}}}{n_{\text{II}} - 1}}$$

where Σ^2_{I} = the sum of the squares of the differences from the mean of the first series ;

Σ^2_{II} = the sum of the squares of the differences from the mean of the second series ;

n_{I} = the number of samples in the first series ;

n_{II} = the number of samples in the second series.

The figure obtained for this value from the two series mentioned above is 0.31 per cent. ; this includes differences due to errors of sampling and analysis, and a reasonable amount of separation of cream ; the probable variation is only 0.11 per cent., and a higher difference than 0.31 per cent. would show either a very abnormal condition of things (cf. Vieth, ANALYST, viii., 2) or unnecessary carelessness.

Variation of Constituents of Solids-not-fat.—In order to ascertain whether all the constituents of the solids-not-fat vary directly as the total percentage, or whether an excess or deficiency of solids-not-fat is due to excess or deficiency of any one constituent, I have examined a large number of analyses of milk in which milk-sugar, proteids, and ash were determined. On plotting out the average figures for solids-not-fat against each of the constituents, I find that the figures for milk-sugar, proteids, and ash, lie each in a series of three straight lines. For each constituent the breaks occur between 8.8 per cent. and 8.9 per cent., and between 8.4 per cent. and 8.5 per cent., and are quite well defined. It is suggestive that the one figure is very near the average percentage, and the other is almost that adopted as the limit for normal milk, and the figures show that it would be difficult to dilute down a milk high in solids-not-fat without arousing a strong suspicion that it is watered. Table II. gives the figures deduced, which are averages, and individual samples may show differences.

TABLE II.

Solids-not-fat.		Milk-sugar.	Proteids.	Ash.
Range.	Average.			
about 10 per cent.	10.0	4.79	4.37	0.84
9.00—9.25	9.10	4.77	3.57	0.76
8.75—9.00	8.87	4.75	3.39	0.73
8.60—8.75	8.67	4.60	3.35	0.73
8.40—8.60	8.50	4.48	3.30	0.72
8.20—8.40	8.30	4.18	3.39	0.73
8.00—8.20	8.10	3.94	3.41	0.75

Any deficiency of solids-not-fat below 9.0 per cent. is chiefly due to a deficiency in the milk-sugar.

Any excess of solids-not-fat above 9.0 per cent. is chiefly due to an excess of proteids.

The ash may be deduced with very fair accuracy from the proteids by the formula $A = 0.36 + 0.11 P$.

Relation between the Proteids and Salts of Milk.—The formula just quoted indicates an intimate connection between proteids and salts of milk; it is, indeed, a matter of common knowledge that the casein is in some way combined with calcium phosphate, but so far as I am aware no attempt has been made to ascertain the exact way in which calcium phosphate is combined.

Following Söldner and Duclaux, I employed Zahn's method of filtration of the milk through a porcelain filter in my experiments on this point. It is usually stated, and I have hitherto accepted this statement, that on filtration through porcelain the casein is left behind and the albumin passes into the filtrate. I find, however, that the whole of the proteids are removed from solution, and have not detected albumin in the filtrate. Whether the difference in results is due to the use of porcelain of different quality I am unable to say; but it may be due to the fact that the difference in concentration of the milk and the filtrate, owing to the removal of fat and proteids, has not been taken into account, and as by neglecting this the casein would be found too low, there would be consequently a difference which might be taken as albumin.

The method of allowing for the difference of concentration is to calculate the constituents of the filtrate to the original milk by multiplying by the percentage of water in the milk, and dividing by the percentage of water in the filtrate; this I believe is correct, and is the most convenient method of making the correction.

I have also made some examinations of whey produced by the action of rennet on milk.

The following are the mean results I have obtained:

		Milk.	Serum from Fresh Milk.	Serum from Heated Milk.	Whey.	Whey Heated.
Total solids	...	12.83	5.09	5.03	6.21	6.12
Fat	...	4.01	—	—	—	—
Sugar	...	4.45	4.45	4.44	4.45	4.45
Proteids	...	3.46	—	—	} 1.24	1.16
Other solids	...	0.16	0.16	0.12		
Ash	...	0.75	0.48	0.47	0.52	0.51
CaO	...	0.17	0.054	0.045	0.051	0.047
P ₂ O ₅	...	0.22	0.097	0.094	0.103	0.095
CO ₂ (combined)	...	0.016	0.016	0.013	not estimated	
Total nitrogen	...	0.54			0.129	0.113
Proteid nitrogen	...	0.54			0.068	0.047
Albumose nitrogen	—				0.061	0.066

Of the total nitrogen of the milk, the casein nitrogen was 0.477 per cent., and the albumin nitrogen 0.063 per cent.

The first point to which attention must be drawn is that the alkalinity of the ash (which is expressed as CO₂) is identical in the milk and the serum; this was found to be the case in three samples. The only conclusion to be drawn from this is that the salts combined with the proteids contain equal amounts of acid and base.

By subtracting the serum lime and phosphoric anhydride from the totals we get

the lime and phosphoric anhydride combined with the proteids. The following is the composition of the matter separated by porcelain :

Proteids	...	...	...	...	...	3.46
Casein nitrogen	...	...	...	...	...	0.477
Albumin nitrogen	...	...	...	...	...	0.063
CaO	...	...	...	...	...	0.116
P ₂ O ₅	...	...	...	...	...	0.123
Ash	...	...	...	...	...	0.27

It will be convenient at this stage to deduce similarly the composition of the curd separated by rennet. This is :

Curd nitrogen	...	...	...	...	...	0.411
CaO	...	...	...	...	...	0.119
P ₂ O ₅	...	...	...	...	...	0.117
Ash	...	...	...	...	...	0.23

While there are left in solution :

Proteid nitrogen	...	...	...	...	...	0.068
Albumose nitrogen	...	...	...	...	...	0.061

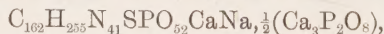
Hammarsten gives the following composition for casein, the curd produced by rennet, and the proteid of the whey :

	Casein.		Curd.		Whey Proteid.	
	Found.	Calculated.	Found.	Calculated.	Found.	Calculated.
Carbon	52.96	52.96	52.88	52.95	50.33	49.72
Hydrogen	7.05	7.03	7.00	7.00	7.00	6.97
Nitrogen	15.65	15.64	15.84	15.88	13.25	13.18
Phosphorus	0.85	0.84	0.99*	0.98	—	—

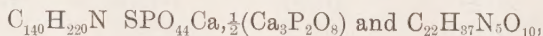
From these figures I have ventured to deduce formulæ, not as absolutely correct, but probable near approximations. They are :

Casein	...	...	...	...	...	$C_{162}H_{258}N_{41}SPO_{52}$
Curd	...	...	...	...	...	$C_{140}H_{222}N_{36}SPO_{44}$
Whey proteid	...	...	...	...	...	$C_{92}H_{137}N_{15}O_{10}$

If we assume that casein separated by porcelain is



and that it is split up by rennet into



we shall find the following figures for 0.477 casein nitrogen :

CaO	...	...	...	...	...	0.119
P ₂ O ₅	...	...	...	...	...	0.121
Na ₂ O	...	...	...	...	...	0.026
Total ash	...	...	...	...	...	0.266

This would be split up by rennet into

Curd nitrogen	...	...	...	...	...	0.419
Albumose (whey proteid) nitrogen	...	...	...	...	...	0.058
Ash	...	...	...	...	...	0.24

* I have inserted this figure.

and the curd would contain the same amounts of lime and phosphoric anhydride as the casein.

As the proteid nitrogen is a little higher (0.068) in the whey than the albumin nitrogen (0.063), and as, moreover, traces of proteid phosphorus were found both by Neumeister's method and that described in "Dairy Chemistry," p. 113 (both of which agreed), it is probable that there is a little curd left in the whey, most likely in suspension, as the whey is not quite clear.

The very close concordance of the figures throughout affords grounds for supposing that the view put forward above is correct. Casein may be regarded as a substituted phosphoric acid, the substituted group having itself an acidic function; this in milk is combined with a molecular proportion of calcium phosphate. A further confirmation of this view is obtained by adding to milk the minimum quantity of acid necessary to just curdle on boiling. If a mineral acid (sulphuric or hydrochloric acid) is used, the quantity necessary to just curdle on boiling is about 8.6 c.c. of normal acid per litre of milk; the quantity calculated to replace the sodium in the formula for milk containing 3.0 per cent. casein, is 8.3 c.c., and the acidity of the serum (16.8°) is practically equal to that of the original milk (16.7° after boiling).

On curdling milk with rennet, and estimating the acidity of the whey, it is found to be less acid; the mean acidity of milk was found to be 19.0 c.c. normal alkali per litre, and the whey (after correcting for the difference of volume due to removal of curd) was 10.6 c.c. normal alkali per litre, or a difference of 8.4 c.c., a figure which is in entire agreement with the view expressed above.

The results on the serum of milk heated to 100° C., which were originally included to study the changes in the albumin, do not show that any great change occurs in the salts on heating; there is a slight deficiency of lime—0.009 per cent.—which is nearly equivalent to the deficiency in the phosphoric acid—0.003 per cent., plus the deficiency in the carbonic acid—which is derived from the combustion of the citrates of milk; this indicates that a slight deposition of calcium citrate and phosphate occurs on heating. Attempts were made to estimate the lime in the slight deposit, but, owing probably to the relatively large bulk of water necessary to wash this, only 0.0012 per cent. on the average was found. It was found also that on boiling milk the acidity was reduced from 19.0 c.c. normal alkali per litre to 16.7 c.c. This is most probably due to the expulsion of free carbonic acid, and is equivalent to $0.0044 \times 2.3 = 0.01$ per cent., or, roughly, 50 c.c. per litre, which is about the quantity found to exist in milk.

The amounts of lime and phosphoric anhydride in heated whey are almost exactly equal to those in the serum from heated milk, indicating that in addition to a partial separation of albumin, a slight deposition of calcium salts occurs.

With regard to the acidity of milk, this can only be due to the presence of acid phosphates and citrates. I find experimentally that while tri-sodium citrate is neutral to phenolphthalein, the neutral phosphate is expressed by the composition $\text{Na}_{1.95}\text{H}_{1.05}\text{PO}_4$ in aqueous solution and $\text{Na}_{1.97}\text{H}_{1.03}\text{PO}_4$ in 5 per cent. milk-sugar solution, and this appears to account for the fact that milk just neutralized to phenolphthalein is slightly reddened by dilution; the end-reaction is not very sharp.

The acidity of the milk, added to the alkalinity of the ash, give a datum for the

estimation of the citric acid in milk. The acidity of boiled milk is 16.8 c.c. normal alkali per litre to phenolphthalein, and as this is due to acid phosphates, this is equal to $16.8 \times \frac{2}{0.97} = 34.6$ c.c. for chemical neutrality, which is equal to $\frac{34.6 \times 0.063}{1.032 \times 10} = 0.218$ per cent. citric acid; the alkalinity of the ash as CO_2 is 0.016 per cent. $= 0.016 \times \frac{63}{22} = 0.046$ per cent. citric acid, or a total of 0.264 per cent. We may presume that, as very little calcium citrate is deposited on boiling, it exists in milk as $\text{R}_2\text{HC}_6\text{H}_5\text{O}_7$, and the citrates would account for 14.4 c.c. normal alkali per litre, and the remainder is accounted for by the phosphate RH_2PO_4 ; this is equivalent to 0.020 per cent. P_2O_5 being present as RH_2PO_4 , while 0.077 per cent. is present as R_2HPO_4 .

The item returned in the analysis as other solids agrees fairly well with the percentage of citric acid deduced, when allowance is made for the carbonic acid in the ash and the hydrogen replaced.

In conclusion, the following shows the distribution of the phosphoric acid of the milk:

{ P_2O_5 as casein, combined with CaNa and	...	0.0605 per cent.
{ P_2O_5 as $\text{Ca}_3(\text{PO}_4)_2$		0.0625 "
P_2O_5 as R_2HPO_4		0.077 "
P_2O_5 as RH_2PO_4		0.020 "
Total P_2O_5		0.220 "

and the analysis of the milk may be written:

Water	...	87.17 per cent.	
Fat	...	4.01	"
Sugar	...	4.45	"
Casein, with the salts in combination	...	3.33	" yielding ash 0.27 per cent.
Albumin...	...	0.40	"
Salts in solution	...	0.73	" " 0.48 "
Total	...	100.09	"

My conclusions differ from those of Söldner in that—

(i.) I consider one-third of the base with which casein is combined in milk to be soda and not lime.

(ii.) I consider that casein forms a molecular compound with calcium phosphate.

(iii.) I express the citrates as dibasic, and not as tribasic, and, consequently, our proportions of mono and dibasic phosphates do not agree.

Before finally concluding, I would point out some objections to my views. First of all, there are possible errors of analysis; and these, as the absolute quantities dealt with are small, may be relatively large. Then I have taken no account of the small amounts of magnesium which may replace calcium; I actually find a rather larger quantity of phosphoric anhydride in the $\text{Ca}_3(\text{PO}_4)_2$ than in the casein, while they should be equal; but against this there is the phosphorus of the lecithin of the fat and the higher percentage of phosphorus in Storch's mucoid proteid, which would give phosphoric anhydride, and which would be included in

the phosphoric acid as calcium phosphate. Finally, I have not assumed that albumin is in combination with bases. I am inclined to disregard these objections, in face of the facts supporting my view.

DISCUSSION.

Mr. BLOUNT said that, for a purpose other than filtration, he was concerned in trying to use "biscuit" porcelain, which he hoped would prove quite impervious, not merely to liquids, but to gases. "Biscuit" porcelain, as it was known in the laboratory, was an extremely impervious material for all ordinary purposes; but it was conceivable that, if heavy pressure were used, it might suffice to filter a turbid liquid very slowly, and to effect important separations. He had himself, however, tried to filter a very turbid and refractory liquid under heavy pressure through "biscuit" porcelain, and had failed entirely to get even a drop through; and he would like to hear whether the porcelain used by Mr. Richmond was of some more porous grade than the kind generally used for laboratory vessels.

Dr. RIDEAL thought that the Society's hearty thanks were due to the author for the papers on this subject which he brought before them annually. Apart from statistical matter, they included references to interesting points bearing on the question of milk constitution—such, for instance, as the valuable suggestions which the present paper contained as to the constitution of the acids present in milk.

The PRESIDENT (Dr. Voelcker) said that in previous reports Mr. Richmond had drawn attention to the fact that each year the average percentage of fat decreased a little. In the results now given for 1900 this decrease continued to be shown, its amount being practically the same as in previous years—namely, about 0.1 per cent. It was to be noticed that the average figures for solids-not-fat, in the case of both the morning and the evening milk, were identically the same for 1900 as for 1899, and the variation in fat between morning and evening milk was also the same as in 1899, the average variation being under $\frac{1}{2}$ per cent. in each case. This was a point of considerable importance in view of what was brought out at the meetings of the Departmental Committee on milk standards, when it was sought to show that much wider differences existed between morning and evening milk than were exhibited by Mr. Richmond's figures. It should, of course, be clearly understood that the morning milk here referred to was the milk actually drawn in the morning, not the milk which was distributed in the morning, and which was probably taken overnight. He agreed with Dr. Rideal as to the value of the addenda which Mr. Richmond usually made to his annual statistics. The points brought out in the present paper with regard to the forms of combination in which lime occurred with the other constituents of the milk were not only of great interest, but of far-reaching importance. Considering the important influence which lime salts exerted in connection with the action of rennet and the formation of curd, there was indicated the necessity for still further investigation into the composition of milk, and into the manner in which the different constituents were bound together.

Mr. RICHMOND said that, as in past years, the great bulk of the work recorded in the paper had been done by Mr. J. B. P. Harrison and Mr. C. H. Rosier, his

assistants, whose help he desired duly to acknowledge. It was quite true that for practically the last twenty years there had been a small but distinct fall in fat, but the average annual decrease was considerably less than 0.1 per cent.; and in 1901, as far as could be told at present, probably a break would occur in the continuity of the decrease, and there would be a rise in the average percentage of fat. The variation in fat between morning and evening milk had been practically the same for the last twenty years—namely, from 0.3 to 0.4 per cent., and it was only extremely rarely that any greater variation occurred. The only occasions on which he had noticed large variations were when there was a large difference in the length of the intervals between milking-times. If, for instance, the intervals were eight hours and sixteen hours respectively, the milk after the sixteen-hour interval would be found sometimes to contain as little as $2\frac{1}{2}$ per cent. of fat, while the milk after the eight-hour interval might contain as much as 5 or 6 per cent. But the intervals were usually very much more even. He had used two kinds of porcelain, one being that used in the Pasteur filter, and the other that sold under the name of “porous balloon filters.” Probably both of these would be much more porous than the kind mentioned by Mr. Blount.

Mr. BLOUNT observed that it would seem desirable that some definite standard of porosity should be adopted.

Mr. RICHMOND said that he had found that with both of the two kinds of porcelain he had used—which certainly differed from one another in porosity—the proteids were completely removed from the milk; and this being so, he had not investigated the matter further.

THE RELATION BETWEEN SPECIFIC GRAVITY, FAT, AND SOLIDS-NOT-FAT IN MILK.

BY NORMAN LEONARD, B.Sc.

In a former paper (ANALYST, xxv., 67-69) the application of the method of least squares to the results of analysis of 137 samples of milk was described, and the most probable values of the constants s and f in the equation $G = Ss - Ff$, representing the relation between degrees of specific gravity (G), percentage of fat (F), and of solids-not-fat (S), were found by that method to be 3.905 and 0.815 respectively. From these results was deduced the equation $F = 0.827T - 0.212G$ for calculating the fat from the total solids (T) and the specific gravity. This formula, like most of the milk formulæ which have been proposed, is based on the assumption that the specific gravity of milk is raised or lowered by a constant amount for each per cent. *by weight* of solids-not-fat or fat respectively. Reasoning by analogy from the properties of other solutions, it would seem probable, however, that the analytical results might be better represented by a formula in which the influence on the specific gravity was assumed to be proportional to the percentage *by volume* of the constituents, or, otherwise expressed, in which the percentages by weight exercised a constant influence on the specific volume, instead of the specific gravity. Such a formula— $G/D = S\sigma - F\phi$, where D is the density of the milk (water = 1)—was constructed by

Richmond (ANALYST, xiv., 121-131), who found, however, that no superior accuracy was obtained by its use.

I have now calculated the value of the constants σ and ϕ by the method previously employed, and have obtained the formula $G/D = 3.775S - 0.743F$, whence $F = 0.836T - 0.221G/D$. The results given by this formula are scarcely so accurate as those given by the simpler formula, as will be seen from the following comparative table :

	Formula. $F = 0.827T - 0.212G.$	Formula. $F = 0.836T - 0.221G/D.$
Average error	- 0.01	+ 0.01
Probable error	± 0.078	± 0.081
Percentage of errors not exceeding 0.1	70	67
Percentage of errors not exceeding 0.2	90	89

The fats calculated by the new formula are, on the average, about 0.02 per cent. higher than those given by the old formula. The difference is greatest in the case of milks with high solids and high specific gravities, whilst with milks having low solids and low specific gravities the two formulæ give more concordant results. Hence the new formula rather accentuates the error inherent in the old formula of giving too high fats when the solids-not-fat are high (*cf.* ANALYST, xxv., 68; xvii., 169-171).

The seasonal variations in the accuracy of the calculated fats are not appreciably different for the two formulæ. The specific gravities in solution of the solids-not-fat and fat, as calculated from the values found for σ and ϕ , are 1.606 and 0.931 respectively, results which compare favourably with those—1.613 and 0.939—calculated by Richmond (ANALYST, xiv., 121-131).

NOTE ON SUBLIMED SULPHUR.

By NORMAN LEONARD, B.Sc.

THE "sublimed sulphur" of the British Pharmacopœia "should not have any action upon litmus," but according to my experience it is rare to meet with specimens absolutely devoid of acidity. Those which I have examined were found to contain from 0.02 to 0.25 per cent. of sulphuric acid, as determined by titrating the aqueous extract of the samples; the average of eight samples was 0.08 per cent. Part of this acidity may be due to oxidation in the process of sublimation, but it may also be formed by exposure to air and moisture. Thus, a quantity of sublimed sulphur which had been rendered perfectly neutral by repeated washing with water and kept in a stoppered bottle whilst still moist was found to be very faintly acid after two weeks, and decidedly acid after three months, whilst at the end of four years the sample contained 0.2 per cent. of sulphuric acid. The latter was determined both by titration and by precipitation as barium sulphate; no sulphurous acid could be detected. A specimen of sulphur which had been thoroughly washed and subsequently dried at 100° showed, after keeping for four years, a barely perceptible

acid reaction, corresponding with the presence of not more than 0.0025 per cent. of sulphuric acid.

I am not aware that the slow oxidation of sulphur in this way has been previously noticed.

ABSTRACTS OF PAPERS PUBLISHED IN OTHER JOURNALS.

FOODS AND DRUGS ANALYSIS.

Lactic Acid in Wine. R. Kunz. (*Zeit. für Untersuch. der Nahr. und Genussmittel*, 1901, iv., 673-683.)—The author states that optically inactive lactic acid is a normal constituent of all wines, often in considerable quantity. The following method is recommended for the determination of this acid in wine: 200 c.c. of the wine are rendered alkaline by the addition of barium hydroxide, and are then evaporated in a porcelain basin to about two-thirds of the original volume. After cooling, the whole is made up again to 200 c.c., well shaken, and filtered; 150 c.c. of the filtrate are now evaporated to a thin syrupy consistency, at the same time passing a current of carbon dioxide through the liquid. When cold, dilute sulphuric acid is added in excess, and the whole liquid and precipitate, after dilution with water, extracted with ether in an apparatus similar in principle to that described in the *ANALYST*, 1892, xvii., 44. The extraction is complete in eighteen hours. Thirty c.c. of water are added to the ether extract, and the ether is driven off on the water-bath. The aqueous solution of the extract is then distilled in a current of steam until all volatile acids have been removed, which is attained when the distillate amounts to 600 to 800 c.c. The residue is made alkaline with barium hydroxide, heated for fifteen minutes on the water-bath, when it should still remain alkaline, and evaporated to about 10 c.c., meanwhile passing a stream of carbon dioxide through the liquid. This residue is then taken up with 40 c.c. of water, made up to 150 c.c. with 95 per cent. alcohol, shaken, and filtered. One hundred c.c. of the filtrate are evaporated until the alcohol is driven off, then made acid with hydrochloric acid, precipitated with sodium sulphate, and the weight of barium sulphate obtained calculated into lactic acid. The results of a number of determinations of lactic acid in wines are given, the quantities found being from 0.1185 to 0.7340 gramme per 100 c.c.

W. P. S.

The Detection of Cocoanut Oil in Butter and Margarine. L. Vandam. (*Ann. de Pharm. de Louvain*, 1901, 201; through *Journ. Pharm. Chim.*, 1901, vi., 273-276.)

1. *Determination of Fatty Acids Soluble in Alcohol.*—Five grammes of the fat are saponified with 25 c.c. of an alcoholic solution of potassium hydroxide (8 grammes per litre of alcohol of specific gravity 0.832). An additional amount of the same

alcohol is then added so as to form, with the initial 25 c.c., alcohol of the required percentage after dilution to 100 c.c.

The soap solution is now diluted to 100 c.c. with water, cooled to 15° C., and again made up to the mark. It is then decomposed with 25 c.c. of standard sulphuric acid equivalent to the potassium hydroxide solution in strength, and the liquid cooled very slowly to 15° C., kept at that temperature for some time, then filtered, and the soluble fatty acids in the filtrate titrated with $\frac{N}{2}$ sodium hydroxide solution. The fatty acids on the filter are dried, and their volume determined when suspended in 10 c.c. of the alcohol. The volume of the precipitated sulphate is also determined and taken into account.

In this way the author obtained the following results, representing the fatty acids soluble in different strengths of alcohol at 15° C., expressed in terms of $\frac{N}{2}$ sodium hydroxide solution :

			ALCOHOL.					
			50 per cent.	55 per cent.	60 per cent.	65 per cent.	70 per cent.	80 per cent.
Cocoanut Oil	...	...	4.3	13.3	44.2	44.0	—	—
Butter	...	...	—	8.5	10.9	25.8	27.7	30.0
Margarine	...	...	—	—	3.6	9.5	22.8	26.2

Five other samples of butter of known purity were also tested with 60 per cent. alcohol, and gave results ranging from 10.3 to 11.8.

2. *Determination of Fatty Acids Soluble in Alcohol but Insoluble in Water.*—Fifty c.c. of the solution in 60 per cent. alcohol obtained in the preceding test are evaporated to three-fourths of the volume, then mixed with boiling water, cooled at the ordinary temperature, and the supernatant liquid filtered. The precipitated fatty acids are washed twice with boiling water, cooled, and filtered. Finally, they are dissolved in boiling alcohol and titrated with $\frac{N}{2}$ sodium hydroxide solution.

The following results were thus obtained : Butter (4 samples), 4.6 to 5.2 ; margarine, 3.1 ; and cocoanut oil, 42.0.

C. A. M.

A New Test for Saccharin. A. Leys. (*Ann. de Chim. anal.*, 1901, vi., 201-206.)—If 10 c.c. of a very dilute solution of copper sulphate or of a ferric salt be mixed with two or three drops of hydrogen peroxide, and warmed with an aqueous solution of an unsaturated organic compound, an intense brown coloration is produced. This reaction is obtained with salicylic acid, benzoic acid, cinnamic acid, saccharin, acetanilide, ortho-phenylene-diamine, antipyrine, pyrrol, thiophen, and furfural. No colour is obtained with alcohol, acetic acid, lactic acid, sucrose, allyl acetate, fumaric acid, menthol, or turpentine.

The brown coloration given by saccharin can be prevented by the addition of a trace of sulphuric acid, and even after warming the mixture for a few moments only a faint yellow tint is produced. After a short time two drops of a very dilute solution of ferric chloride are added, and a violet coloration is obtained. This reaction, which is due to formation of oxybenzoic acid, is also given by benzoic acid. By using very

dilute solutions of ferric chloride and hydrogen peroxide in the cold, the addition of the acid is rendered unnecessary.

In testing milk for saccharin, 50 c.c. are treated with 100 c.c. of a 10 per cent. solution of potassium bisulphate, containing 10 c.c. of 99 per cent. alcohol, and the precipitated casein filtered off. The filtrate is shaken with two portions of ether, emulsification being prevented by the addition of 2 drops of alcohol, the ethereal extracts evaporated to dryness at 90° C., and the residue dissolved in 5 c.c. of boiling water. When cold, the solution is tasted, and, if sweet, is tested with 2 drops of a very dilute solution of ferric chloride, and 2 c.c. of dilute hydrogen peroxide, and left for thirty minutes. In the presence of saccharin a violet tint is slowly developed.

The ferric chloride solution is prepared by diluting 2 c.c. of a solution of 30° Bé. to 100 c.c., and the hydrogen peroxide by diluting 1 c.c. of the ordinary 10 volume solution to 200 c.c.

C. A. M.

An Improvement on the British Pharmacopœia Santonin Test. P. Pain. (*Pharm. Journ.*, 1901, lxxvii., 131.)—The test consists in warming a few crystals of santonin with 2 or 3 c.c. of ethyl nitrite solution (British Pharmacopœia strength). On the addition of a few drops of potassium hydroxide solution, a fine rose-red coloration is produced. No colour is produced until the potassium hydroxide is added, and this serves to distinguish it from such bodies as aloin and resorcin, both of which give a red colour with ethyl nitrite alone. Thymol, with the same test, yields a dark yellow solution. One milligramme of santonin can be detected by this method.

W. P. S.

Determination of Cocaine. W. Garsed and J. N. Collie. (*Pharm. Journ.*, 1901, lxxvii., 222 and 254.)—The method which the authors found to be the most satisfactory one consists in slowly adding an excess of $\frac{1}{10}$ iodine solution to the cocaine solution, filtering off the brown precipitate formed through an asbestos filter, and titrating back the iodine in the filtrate with $\frac{N}{10}$ sodium thiosulphate solution. The presence of ecgonine does not interfere with the results if $\frac{1}{100}$ iodine solution be used; but benzoyl ecgonine makes the results too high. As, however, this substance is not extracted by either ether or petroleum spirit from alkaline aqueous solutions, it may be readily separated from cocaine.

W. P. S.

The Determination of Aconitine in Extracts of Aconite. H. Ecalle. (*Journ. Pharm. Chim.*, 1901, xiv., 97-102.)—This method is based on the precipitation of aconitine by silico-tungstic acid. The silico-tungstate is washed, dried, and ignited, leaving a mixture of tungstic and silicic acids, $12\text{WO}_3 \cdot \text{SiO}_2$.

According to Bertrand (*ANALYST*, 1899, 187), the weight of the acids, multiplied by the factor 0.907, gives the corresponding amount of aconitine, but the author has found by test experiments that this factor gives too high results.

Bertrand's factor was based upon the assumption that the silico-tungstate con-

tained 4 molecules of the alkaloid, but the author obtained results in close agreement with theory by calculating the factor from the formula :



and he therefore adopted 0.793 as the coefficient.

In determining the aconitine in a tincture of aconite, a definite weight (125 grammes) is evaporated on the water-bath, and the cold residue treated with 6 to 7 c.c. of dilute nitric acid (1 : 10). The mixture is transferred to a separating funnel, rendered alkaline with 3 to 4 c.c. of ammonium hydroxide, and extracted with successive portions of 100 c.c. of ether, of specific gravity 0.720, at 15° C., until a few drops of the solution on evaporation give no reaction with Mayer's reagent.

The united extracts are shaken with 6 to 7 c.c. of nitric acid (1 : 10) to which have been added 12 to 15 c.c. of water. The acid layer is withdrawn, and the ether washed with water until the washings are no longer acid. The acid extract and washings are gently heated to expel any ether, then cooled, and the alkaloid precipitated with 7 to 8 c.c. of a 5 per cent. solution of silico-tungstic acid, in the presence of an excess (12 to 15 c.c.) of 10 per cent. nitric acid.

The liquid is heated nearly to the boiling-point, then cooled, and allowed to stand for twenty-four hours. The precipitate is collected, washed, dried, ignited in a weighed porcelain crucible, and its weight multiplied by the factor 0.793.

(Probably the author and Bertrand were working with different kinds of aconitine.—W. C.)

C. A. M.

Assay of Extractum Cinchonæ Liquidum. F. H. Alcock. (*Pharm. Journ.*, 1901, lxxvii., 90.)—Five grammes of the extract are weighed out into a 4-ounce white glass bottle fitted with a good cork. Fifteen c.c. of benzolated amylic alcohol and 10 c.c. of normal alcoholic potash solution are now added ; the bottle is shaken and allowed to stand in a warm place for a few minutes. The *clear* liquid is then poured off into a separator, the contents of the bottle again shaken with 15 c.c. of benzolated amylic alcohol, and poured off after a few minutes. After a third extraction with benzolated amylic alcohol, the contents of the separator are washed with two or more separate quantities of 5 c.c. of water, with or without the addition of 1 c.c. of a 10 per cent. solution of ammonia, shaken well, warmed, allowed to settle, and the aqueous liquid removed. This contains all the glycerin and often a trace of alkaloid. The solvent liquid, now free from colouring matter, alkali, and glycerin, is extracted three times with acidulated water. This aqueous extract is then treated according to the official method. The slimy residue does not retain any alkaloid.

W. P. S.

The Determination of Phenol when Mixed with Resinous Substances. J. C. Thresh. (*Pharm. Journ.*, 1901, lxxvii., 138.)—Having to determine the amount of phenol in samples of carbolized gauze, in which the phenol is "fixed" to the gauze by the aid of resin, the author used the following process : About 20 grammes of the gauze were placed in a flask holding about 700 c.c., and connected to a con-

denser. Five hundred c.c. of water acidulated with hydrochloric acid were then added, and a few fragments of granulated zinc. After slowly distilling over about 300 c.c., practically the whole of the phenol was in the distillate, and was determined by the usual bromine method. The process gave good results when carried out on test samples.

W. P. S.

ORGANIC ANALYSIS.

Notes on some Vegetable Waxes. M. Greshoff and J. Sack. (*Rec. trav. chim. des Pays Bas*, 1901, xx., 65; through *Chem. Zeit. Rep.*, 1901, 177.)—The wax obtained from the leaves of the plantain (pisang) forms white crystalline masses melting at 79° to 81° C., and having the specific gravity of 0.963 to 0.970 at 15° C. The wax is only slightly soluble in boiling ethyl alcohol, but readily dissolves in hot turpentine, amyl alcohol, and carbon bisulphide. Its acid value is 2 to 3; its saponification value, 109. On hydrolysis it yields "pisang-cerylic acid," $C_{24}H_{48}O_2$, which melts at 71°. "Pisang-ceryl alcohol," $C_{13}H_{28}O$, melts at 78°. The *Ficus ceriflua* gives a wax which is brown outside, yellowish in the centre of the mass, and has a specific gravity 1.015. It is soluble in all the usual solvents at the boiling-point, and by continued boiling it may be almost entirely dissolved in ethyl alcohol, separating again when cold. After purification with alcohol the wax melts at 61° C., and yields "Fico-cerylic acid," $C_{13}H_{26}O_2$, melting at 57°, and "Fico-ceryl alcohol," $C_{13}H_{26}O$, melting at 198°. By dry distillation it gives an aqueous distillate of acetic and propionic acids, and an oily liquid. The latter contains a colourless fluorescent hydrocarbon $C_{14}H_{26}$ which boils at 220°, and has an odour like petroleum and turpentine; also two crystalline bodies: an acid, $C_{12}H_{24}O_2$, melting at 55°, and an alcohol, $C_{14}H_{28}O$, melting at 51°. On destructive distillation pisang wax yields a hydrocarbon $C_{16}H_{34}$ boiling at 280°, and an acid $C_{27}H_{54}O_2$ which melts at 58°, and is therefore not identical with cerotinic acid. Beeswax on distillation gives a hydrocarbon $C_{15}H_{30}$, boiling between 240° and 250°, identical with one of the constituents of petroleum; also a solid body (perhaps $C_7H_{14}O_2$) melting at 63°, and a second substance melting at 56°, which evidently belongs to the olefine series.

F. H. L.

Mixed Glycerides in Natural Fats. D. Holde and M. Stange. (*Berichte*, 1901, xxxiv., 2402-2408.)—Henriques and Künne (*ANALYST*, xxiv., 185) confirmed Heise's statement of the occurrence of oleodistearin in Mkani fat, and their work on this subject has since been continued by the authors, who have investigated a number of specimens of olive oil, which has usually been regarded as essentially a mixture of various triglycerides.

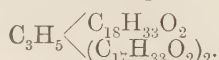
An ethereal solution of the olive oil was chilled in a bath of alcohol and solid carbon dioxide at a temperature of -40° to -45° C., and the deposit repeatedly recrystallized first at the same temperature, then from smaller quantities of ether at -20° C., and finally freed from liquid glycerides by continued recrystallization from a mixture of alcohol and ether at the ordinary temperature.

In this way from 5 to 10 grammes of a solid glyceride resembling porcelain in appearance were obtained from 400 to 700 grammes of the oils. The filtrate when

cooled to -50° to -60° C. yielded a crystalline deposit, which apparently consisted mainly of olein, since it melted at the ordinary temperature and had an iodine value of 82.

The solid glyceride melted at about 1° above or below 30° C., according to whether it had been previously fused or not, and in this respect behaved like Heise's oleodistearin.

It had the following physical and chemical constants: Potash value, 196.6; molecular weight 857 to 859.6; iodine value, 29.8 to 30.1; melting-point, 29° to 31.7° C.; fatty acids per cent. 95.82; specific gravity, 0.9948. These figures agree well with the theoretical values for oleodimargarin—



The constants of the mixed fatty acids from the glyceride are given in the following table together with the theoretical values for margaric, palmitic, and oleic acids:

	Solid Fatty Acids of Glyceride.	Theory for Margaric Acid.	Theory for Palmitic Acid.	Liquid Fatty Acids of Glyceride.	Theory for Oleic Acid.
Saponification value	210.9; 211.9 (215.6)	208	219	199.1	198.9
Mean mol. weight	265.4	270	256	282.0	282
Iodine value ...	0	0	0	90.0; 91.9	90.5
Melting-point ...	52° - 53° C.; 54° - 56° C. 54.6° , 57° , 59 - 61° C.	59.9° C.	62° C.	Liquid at ordinary temperature.	Liquid at ordinary temperature.

The ratio of solid to liquid fatty acids was as 2.2 : 1, whilst the theoretical ratio for oleodimargarin is 1.9 : 1. The liquid acids were separated by extracting the lead salts of the mixed fatty acids with ethyl sulphuric acid, and the oleic acid purified by extracting its barium salt with hot alcohol. It was concluded that the margaric acid was not a mixture of palmitic and stearic acids, because it was found impossible to obtain a fraction melting higher than 59° to 61° C., either by crystallization from petroleum spirit or by fractional precipitation with magnesium acetate. On the other hand, an artificial mixture of stearic and palmitic acid melting at 55° C. was readily separated by Heintz's method into its constituent fractions with the correct melting-points.

In an analogous experiment with bone oil the solid glycerides thus separated only had iodine values of 2.2 to 7.7, so that the authors concluded that it was improbable that mixed glycerides containing oleic acid were here present. C. A. M.

Characteristics of Sunflower Oil. F. Jean. (*Ann. de Chim. anal.*, 1901, vi., 166, 167.)—It is estimated that 100 kilogrammes of the seeds of the sunflower yield 15 to 20 kilogrammes of oil by cold expression. The oil first obtained is pale yellow and limpid, and has a neutral taste and odour. It is chiefly used as an edible oil in Eastern Russia. Oil of the second expression is somewhat more coloured, and is

used as a lamp oil and in the manufacture of varnish. A sample examined by the author gave the following results:

Specific gravity at 15° C.	...	...	...	0.925
Oleo-refractometer reading	...	...	...	+ 22°
Saponification value	...	...	...	192
Iodine value	...	...	...	124
Critical temperature of solution (Alcohol, 94 per cent.)	...	...	...	104° C.
Melting-point of fatty acids	...	...	...	22° C.
Unsaponifiable matter	...	...	...	0.72 per cent.
Acidity as oleic acid	...	...	...	3.102 „
Solubility in alcohol	...	...	...	0.60 „

The oil reduced Becchi's reagent, but gave no coloration in Halphen's or Baudouin's tests. With Brulle's reagent (alcoholic solution of silver nitrate) it gave an orange coloration. When tested by Livache's method it absorbed 4.4 per cent. of oxygen in five days, and when exposed by itself to the air in a thin film it dried in nine days.

C. A. M.

INORGANIC ANALYSIS.

The Precipitation of Tin from its Sulpho-Salts and its Separation from Antimony by Electrolysis. H. Ort and W. Klapproth. (*Zeits. f. angew. Chem.*, 1901, 817.)—The authors have made a thorough examination of this problem, and claim to have found a satisfactory method. The apparatus consists of a glass dish, which contains an anode of platinum gauze and a porous cell, the upper part of which is surrounded by a rubber band to prevent creeping. This contains the anode and the anode solution. Antimony and tin, in the ordinary course of chemical analysis, are obtained as sulphides. These are dissolved in the smallest possible quantity of sodium sulphide, and made up to a definite bulk in a graduated flask. In one portion of this the antimony alone is determined, in another the antimony and tin together. The presence of polysulphides makes no difference; for as the solution is only placed in the cathode compartment, reduction is brought about by the current. But if much polysulphide is present, it is better to treat first with hydrogen peroxide. Not more than 0.25 gramme of antimony or 0.50 of antimony and tin should be present. For the determination of the antimony alone 8 grammes of sodium sulphide are added to the solution, which is then made up to 80 to 96 c.c., and poured into the glass basin. The porous cell in which the anode reposes contains 5 to 6 grammes of sodium sulphide dissolved in about 50 c.c. of water. The electrolysis is carried out in the cold with a current of a density of 0.1 to 0.2 ampère per square centimetre. In seven hours 0.25 gramme of antimony is entirely precipitated.

The determination of antimony and tin is carried out in the same kind of apparatus. The solution is placed in the glass basin with sufficient ammonium sulphate to convert all the sodium sulphide present into sodium sulphate. Further, 2 grammes of ammonium sulphate and 40 grammes of Glauber salt are added, and

the liquid is made up to 80 or 90 c.c. and warmed to about 70° C. In the porous cell are placed 2 grammes of ammonium sulphide and 30 grammes of Glauber salt dissolved in 50 c.c. of water. Electrolysis is carried out with an initial potential difference of 2 volts and a current density of 0.3 to 0.5 ampère, and at a temperature of 60° to 70° C. In two hours the whole of the antimony and tin are deposited, together with much sulphur. To purify the deposit the cathode is taken out of the cell and put into another containing 25 grammes of Glauber salt dissolved in 125 c.c., and electrolysis is continued for another half-hour with 0.5 to 1 ampère.

In both determinations the following rules should be observed. The porous cell should not be introduced into the glass basin containing the cathode liquid until the anode solution has soaked through the pores, otherwise the resistance will be too high. The level of the anode solutions should be kept $\frac{1}{2}$ to 1 centimetre above that of the cathode solution. The best material to use for the anode is a carbon rod about 1 centimetre in diameter in the case of weak currents. For strong currents, as in removing the sulphur, platinum should be used. It is not necessary to wash the deposits without interrupting the current. The cathode is lifted and rapidly rinsed. To remove the deposits of antimony and tin from the electrode, it is placed in a beaker containing strong hydrochloric acid. As soon as the evolution of gas ceases the electrode is rinsed, and placed in a second beaker with a solution of nitric and citric acids.

A. M.

Thiocyanate as an Indicator in the Reduction of Ferric Salts before Titration. A. Ebeling. (*Zeits. öffentl. Chem.*, 1901, vii., 144; through *Chem. Zeit. Rep.*, 1901, 166.)—The author suggests an addition of 1 or 2 drops of a 10 per cent. solution of potassium thiocyanate to a ferric solution before it is reduced with sulphuric acid and zinc as a preliminary to the titration with permanganate. The red colour produced by the indicator gradually diminishes in intensity as reduction proceeds, until when all the iron is in the ferrous state the liquid is colourless. After cooling it can be titrated with permanganate in the ordinary fashion.

F. H. L.

Detection and Estimation of Nitric Acid in Combination with the Alkali Metals. E. P. Perman. (*Chem. News*, lxxxiii. (2161), 193.)—The alkali-metal nitrate is heated with a sulphate of a metal not belonging to the alkali group—*e.g.*, anhydrous potash alum—whereupon fumes of nitrogen peroxide are evolved. Oxygen is also liberated, leaving the alkali sulphate with alumina and the excess of the alum. After continuing to heat at low redness for one or two minutes the residue is weighed, the loss of weight, calculated as N_2O_5 , enabling the percentage of combined nitric acid to be determined. In the case of potassium nitrate, the results work out to within 0.1 to 0.2 of the theoretical percentage. In presence of a chloride, however, the formation of volatile aluminium chloride vitiates the results.

C. S.

The Pulverization of Substances. W. Hempel. (*Zeits. f. angew. Chem.*, 1901, 843.)—Comparative experiments were carried out to ascertain what material is the best to use for pulverizing a hard substance such as glass. Pestles and mortars of the same dimensions, but of different materials, were used, and 10 grammes

of glass were powdered fine in each. The loss of weight of the mortar and pestle was ascertained in each case, with the following result :

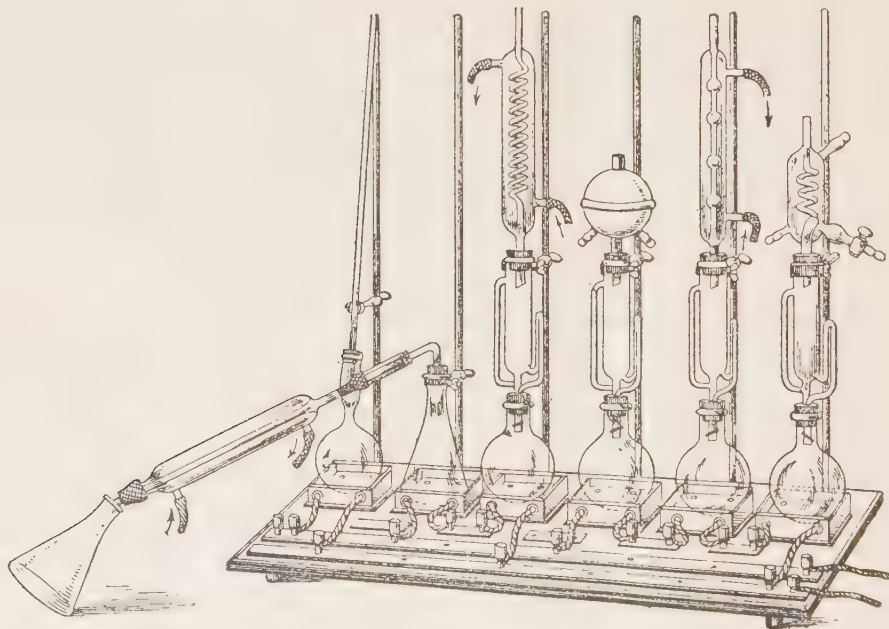
Agate	...	...	...	0.053	gramme.
New steel	...	...	...	0.031	„
Used steel	...	...	...	0.005	„
New hard cast-iron	...	...	...	0.042	„
Used „	„	„	...	0.014	„
Bottle glass	...	...	...	0.027	„

Steel gave by far the best result. Steel was also compared with porcelain in another experiment, and was found to be better than the latter. A steel mortar may be very economically made by pressing a piece of steel plate to the required shape, hardening it, and screwing it on to a wooden block.

A. M.

APPARATUS.

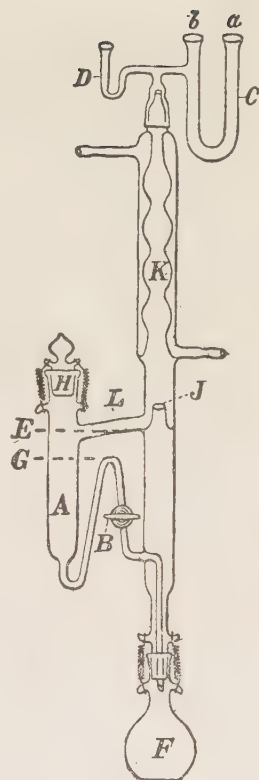
An Electrically Heated Extraction Apparatus. J. Sebelien. (*Chem. Zeit.*, 1901, xxv., 485.)—Three advantages are claimed for this apparatus : (1) There is no danger of fire when volatile and inflammable solvents are being used ; (2) there is no steam to condense on the outside of the upright condenser ; (3) the tare of the flasks is not affected by deposition of “fur” from the water-bath—in fact, the apparatus can be safely left running with ether, etc., all night, if so desired. It



consists of a slate base, with six hot plates 10 × 10 centimetres in size, in which the resistances are placed ; round the plates are iron sides, to hold sand or asbestos in position. The connections are made with movable plugs, so that, according to the temperature required, each plate can be arranged in parallel, or two or more in series. With a 110-volt supply, a current of 0.8 ampère will heat 100 c.c. of water to the

boiling-point in about twenty-five minutes, when the plate is in parallel; and, as shown in the diagram, one flask can be kept at a temperature suitable for work with alcohol, two others at a lower one to suit petroleum spirit, and the three remaining plates at a still lower heat for ether.

F. H. L.



New Fat-Extracting Apparatus. Jerwitz. (*Chem. Zeit.*, 1901, xxv., 437.)—This apparatus has the advantage of being made entirely of glass, the usual cork or rubber stopper above and below the extractor being done away with. The material to be extracted is placed within a paper thimble in the vessel A, which is then filled up to the level E with ether. At the close of the operation the cock B is shut, when the solvent all collects in A, and F can be removed for drying. The ground stoppers of both vessels are secured in place with spiral springs. C is a calcium chloride tube; D contains one drop of mercury to act as a safety-valve in the event of C becoming blocked.

F. H. L.

ADMIXTURE OF GLUCOSE WITH MARMALADE.

KING'S BENCH DIVISION.

(Before the LORD CHIEF JUSTICE, MR. JUSTICE DARLING, and MR. JUSTICE CHANNELL.)

SMITH v. WISDEN AND OTHERS.

(From the "Times" of November 23, 1901.)

THIS was an appeal by Mr. George Smith, a grocer, from the confirmation by the Horsham Quarter Sessions of a conviction under the Sale of Food and Drugs Act, 1875 (38 and 39 Vict., c. 63), section 6, whereby the appellant was convicted of selling, to the prejudice of the purchaser, a pot of marmalade not of the nature, substance, and quality demanded. The case stated was as follows: "1. The appellant is a retail grocer carrying on his business at Worthing, in the county of Sussex, and on February 7, 1901, Frederick White, Inspector under the Food and Drugs Act, 1875, in answer to his application for a 2-pound pot of marmalade, was served on behalf of the appellant with a pot of marmalade which bore a red label which, so far as is important to the case, was as follows: 'Crosse and Blackwell's pure orange marmalade, manufactured entirely from Seville oranges and warranted pure.' No indication beyond the label was given to the purchaser as to the composition of the marmalade. It was admitted before the Court of Quarter Sessions that all the formalities required by the Sale of Food and Drugs Acts were complied with by the inspector. 2. The purchase of the said pot of marmalade was made in consequence of a circular issued by the Local Government Board and received by the Chief Constable of West Sussex, of which the following is a copy: 'I am directed by the Local Government Board to inform the council that they have had under consideration the

statements which have been made relative to illness in different parts of the country, alleged to be caused by the drinking of beer containing arsenic. The presence of arsenic is said to have been due to the brewing of the beer with glucose or other substitutes for sugar prepared with commercial sulphuric acid in which arsenic was accidentally present. Without expressing any opinion on this question, but with a view of pointing out a means of discovering whether any risk is likely to arise in the district from the use of beer containing injurious ingredients, the Board direct me to draw attention to the powers which the council possess under the Sale of Food and Drugs Acts of purchasing and submitting samples of beer for analysis by the Public Analyst, and to recommend that samples should be taken forthwith. I am at the same time to state that glucose and other sugar substitutes are used not only in the brewing of beer, but also in the making of jams, syrups, sweets, and similar articles of food, and the Board suggest for the consideration of the council whether it would not be well that samples of some or all of such articles which are on sale in the district should be purchased and submitted to the Public Analyst for analysis. I am to add that the Board are informed that there is no difficulty in ascertaining whether beer or other articles of food contain arsenical poison.' The conviction was in the following terms: 'In the County of Sussex Petty Sessional Division of Worthing, before the Court of Summary Jurisdiction, sitting at the Town Hall, Worthing, the 6th day of March, 1901, George Smith, of 113 and 115, Montague Street, Worthing, in the said county (hereinafter called the defendant), is this day convicted for that he, on the 7th day of February, 1901, at the parish and borough of Worthing, in the county aforesaid (by the hands of George William Smith, his son and agent) did unlawfully sell to the prejudice of one John Humphrey (the purchaser) a certain article of food—to wit, marmalade—which was adulterated with 13 per cent. of starch glucose, and was not of the nature, substance, and quality demanded by the purchaser, contrary to section 6 of the Food and Drugs Act, 1875. And it is adjudged that the defendant, for his said offence, do forfeit and pay to the clerk of this Court, Bank Buildings, Worthing, aforesaid, the sum of £1, and do also pay to Henry White, the informant, the sum of 12s. for costs forthwith. And in default of payment it is adjudged that the sums due under this adjudication be levied by distress and sale of the defendant's goods, and in default of sufficient distress that the defendant be imprisoned in his Majesty's prison at Lewes, and there kept for the space of fourteen days provided that, should the defendant pay to the governor of the said prison any sum in part satisfaction of the sum herein adjudged to be paid, including the costs and charges of the said distress and commitment and his conveyance to the said prison, the term of imprisonment shall be reduced by a number of days bearing as nearly as possible the same proportion to the total number of days for which the defendant is sentenced as the sum so paid bears to the sum for which he is so liable.—T. F. WIDEN, H. HARGOOD, Justices of the Peace for the county aforesaid.' The certificate of the County Analyst, Otto Hehner, was as follows: 'West Sussex County Council. Sale of Food and Drugs Acts. To Superintendent W. Bridger, Worthing,—I, the undersigned public analyst for the county of West Sussex, do hereby certify that I received on the 8th day of February, 1901, from Superintendent Bridger, by registered post, a sample of marmalade for analysis (which then weighed 10 ounces), and have analysed the same, and declare the result of my analysis to be as follows: I am of opinion that the same is a sample of marmalade, or I am of opinion that the said sample contained the parts as under or the percentage of foreign ingredients as under: Starch glucose, 13 per cent. Observations.—The sample which was marked No. 231 was free from arsenic, from salicylic acid, and fruit other than orange. As witness my hand this 15th day of February, 1901, OTTO HEHNER, Public Analyst, at 11, Billiter Square, London, E.C.' 3. It was proved before the Court of Quarter Sessions that starch glucose is composed of 40 per cent. of dextrose, 40 per cent. of dextrine, and 20 per cent. of water. That dextrose is sugar to all intents and purposes. 4. That dextrine is a gummy substance, and has not any sweetening property whatever, and is a substance largely used for the gumming of labels and other similar purposes.

That glucose, though classed as a sugar for purposes of taxation, was not a sugar as understood by the general public. 5. It was proved that glucose had been used in the manufacture of marmalade (for a period which commenced fifteen years before the date of this case) by a large number of manufacturers, but was not so used by all, and never has been used by all. 6. That there was a general and common understanding that marmalade was a preserve composed of fruit boiled with cane or beet sugar, but that there was no legal standard for the making of marmalade, and that manufacturers varied in the recipes they used. 7. That the use of glucose to the extent contained in the analysed article was not injurious to health. That the use of glucose prevented the marmalade from crystallizing, and had a tendency to prevent mildewing and fermenting. 8. It was contended by the appellant (1) that the sale was not to the prejudice of the purchaser within the meaning of the 6th section of the Sale of Food and Drugs Act, 1875; (2) that as there is no standard for making of marmalade the addition of starch glucose was not an offence under the Act; (3) that upon the facts proved there was no evidence to sustain the conviction. 9. The Court found (1) that in asking for orange marmalade the purchaser desired to buy a substance composed of oranges cooked or preserved with cane or beet sugar, and had not consented to be served with a preserve to which starch glucose was added; (2) that the sale of the article, which contained 13 per cent. of starch glucose, was a sale to the prejudice of the purchaser; and (3) was a sale of an article not of the nature, substance, and quality of the article demanded, and affirmed the conviction and dismissed the appeal. The question for the Court is (1) Was the Court of Quarter Sessions right upon the facts proved before it in dismissing the appeal? (2) If the Court should be of opinion that the judgment of the Court of Quarter Sessions was correct, then the order of that Court dismissing the appeal with costs will stand. (3) If the Court should be of opinion that the judgment of the Court of Quarter Sessions is wrong, then this case is to be remitted to the said Court to enter judgment allowing the appeal with costs."

Mr. BOUSFIELD, K.C., and Mr. MORTON SMITH appeared for the appellant; Mr. BOXALL for the respondents.

THE LORD CHIEF JUSTICE: What evidence is there that the inspector thought he was going to get cane or beet sugar?

MR. JUSTICE CHANNELL: I should think that marmalade is much older than the use of cane or beet sugar.

MR. BOUSFIELD: You will remember that some years ago there often used to be a layer of crystallized sugar on the top of jam. Glucose prevents that.

THE LORD CHIEF JUSTICE: I am not upon jam, but upon marmalade.

MR. BOUSFIELD, continuing, submitted that there was no evidence that there was a sale to the prejudice of the purchaser.

THE LORD CHIEF JUSTICE: I think you are entitled to say that if there is no adulteration something more than a different article being sold to that asked for is necessary.

MR. BOUSFIELD, continuing, submitted that the present case was not within the Act at all. He cited "*Goulder v. Rook*" (1901, 2 K.B., 290). The section did not apply where there was a mixture with no fixed standard, "*Dickens v. Randerson*" (1901, 1 K.B., 437), "*White v. Bywater*" (19 Q.B.D., 582). Where there was no fixed standard it could not be said that the purchaser expected to get marmalade as defined in the dictionary. The only true inference was that he expected to get that which he had been accustomed to get for years. It was found that there was nothing injurious to health.

THE LORD CHIEF JUSTICE: That is clear.

MR. BOXALL, for the respondents, submitted that the magistrates were entitled to rely upon their own knowledge in drawing the inference as to whether the marmalade was inferior. It was essentially a case for the magistrates to decide, "*Webb v. Knight*" (2 Q.B.D., 530). It was to the prejudice of the purchaser, *Hoyle's case* (4 Q.B.D., 233). The appellant had to

make out he was within the exception. The magistrates were entitled to rely upon their own knowledge, "Short v. Robinson" (63 J.P., 295).

Mr. JUSTICE CHANNELL: I cannot help thinking that people nowadays think that glucose is something dangerous. They would not have done so two or three years ago.

The LORD CHIEF JUSTICE, in giving judgment yesterday, said that the statements in the case as affording the foundations for the findings were unsatisfactory. As to what the man asked for, the Court was concluded by the finding of the justices, but he should not have come to the same conclusion. There were many other things that were perfectly proper to put in marmalade besides sugar, and which a purchaser might not know anything about. It had been judicially decided that the difference between the article demanded and that supplied must be to the prejudice of the purchaser. The magistrates had found as a fact that there was an alternative ingredient. It was found that there was no legal standard, that there was a frequent but not exclusive use of glucose, and a variation of recipes. Glucose was found not to be injurious to health. The Act ought not to be construed as an instrument of oppression. Its object was the protection of health. In the present case an article was given to the purchaser which, if different, was rather better. There was no evidence of any inferior quality or of adulteration in the ordinary sense of the word. The conviction must be quashed.

Mr. JUSTICE DARLING and Mr. JUSTICE CHANNELL concurred.

Conviction quashed.

REPORT OF THE COMMITTEE ON FOOD PRESERVATIVES.

THE Departmental Committee on Food Preservatives appointed by Mr. Chaplin in 1899 has now issued its report. The members of the Committee were the Right Hon. Sir H. E. Maxwell, Bart., M.P., Professor T. E. Thorpe, C.B., D.Sc., F.R.S., Dr. H. T. Bulstrode, and Dr. F. W. Tunnicliffe.

The report contains a large amount of original information deeply interesting to the Public Analyst. It is a bulky volume of some 500 pages, and may be obtained from Messrs. Eyre and Spottiswoode, the price being 4s. 3d. We reprint the recommendations of the committee, and also give a summary of the opinions expressed by one dissentient member:

RECOMMENDATIONS.

"(a) That the use of formaldehyde or formalin, or preparations thereof, in foods or drinks, be absolutely prohibited, and that salicylic acid be not used in a greater proportion than 1 grain per pint in liquid food and 1 grain per pound in solid food. Its presence in all cases to be declared.

"(b) That the use of any preservative or colouring matter whatever in milk offered for sale in the United Kingdom be constituted an offence under the Sale of Food and Drugs Acts.

"(c) That the only preservative which it shall be lawful to use in cream be boric acid, or mixtures of boric acid and borax, and in amount not exceeding 0.25 per cent. expressed as boric acid. The amount of such preservative to be notified by a label upon the vessel.

"(d) That the only preservative permitted to be used in butter and margarine be boric acid, or mixtures of boric acid and borax, to be used in proportions not exceeding 0.5 per cent. expressed as boric acid.

“(e) That in the case of all dietetic preparations intended for the use of invalids or infants, chemical preservatives of all kinds be prohibited.

“(f) That the use of copper salts in the so-called greening of preserved foods be prohibited.

“(g) That means be provided either by the establishment of a separate court of reference or by the imposition of more direct obligation on the Local Government Board to exercise supervision over the use of preservatives and colouring matters in foods, and to prepare schedules of such as may be considered inimical to the public health.”

One member of the committee (Dr. Tunnicliffe), while agreeing with the report in general, takes exception to one of the conclusions arrived at (paragraph 127) and to the recommendation marked *f*. The former states that it was found to be undesirable that copper or other poisonous metallic substance should be added to food; the latter recommends prohibition of their use. In defence of his opinion, Dr. Tunnicliffe urges that many articles of diet naturally contain copper, that this metal is constantly being introduced into food by the use of copper cooking utensils, and that the copper so taken up is converted into a relatively insoluble and unabsorbable compound. He thinks that the small amounts of copper contained in preserved peas are harmless, since peas are taken in comparatively small quantities, and that no analogy can be drawn between this compound of copper in peas and minute quantities of lead in water or arsenic in beer, both of which liquids are consumed in large quantities. He points out that in France an order prohibiting this addition had to be subsequently rescinded, and that in Germany, where a similar prohibition exists, it is quite possible to obtain copper-greened peas in the open market, thus showing that the enforcement of the order is difficult. Dr. Tunnicliffe points out the value of appearance in rendering foods appetizing. He thinks the public taste should not be denied the gratification of having a perennial supply of green vegetables, nor the thriving industry which produces them be destroyed. He is satisfied that excessive amounts of copper are frequently used for this purpose, but that, after diligent inquiry, no injurious results have been traced to the use of peas containing these large quantities. He recommends that only the amount of copper absolutely necessary should be added; that such amount should be declared; and that not more than the equivalent of half a grain of metallic copper per pound should be added.

COMBINED APPOINTMENTS OF MEDICAL OFFICER OF HEALTH AND PUBLIC ANALYST.

THE following extract from the proceedings of the Council of the Institute of Chemistry will be read with interest by all Public Analysts:

“The Council have repeatedly addressed the Local Government Board for England and Wales on the undesirability of the appointments of Medical Officer of Health and Public Analyst being combined in one person. There has been a growing tendency in the last few years on the part of Borough Councils and other local authorities, generally with a view to economy, to create such combined appointments.

“On July 15 a letter on this matter was addressed to the President of the Local Government Board by the Presidents of the Institute and the Society of Public Analysts, who drew attention to the importance of requiring adequate evidence of training in chemistry from any person nominated by a local authority for appointment as Public Analyst under the Sale of Food and Drugs Acts. The opinion was expressed that evidence of a systematic course of training in general theoretical and practical chemistry, followed by special experience in the analysis of food and drugs, should be demanded of all candidates offering themselves for the position of Public Analyst. It is not suggested that it is impossible to find Medical Officers of Health who have the necessary knowledge and experience, but that the extent of the training in chemistry required to be taken by medical practitioners in the course of their professional education falls far short of that necessary for the proper conduct of the duties and practice of a Public Analyst, and that medical practitioners, as such, cannot be expected to be able to deal efficiently with such problems as a Public Analyst has to encounter. Moreover, when the appointments are proposed to be combined, the selection of candidates for the two positions must necessarily be limited.

“The nature of the duties of a medical officer may be such as to require at times his entire attention (as, for example, in the event of epidemics), the consequence being that where the appointments are combined the discharge of his duties as Public Analyst may be neglected, and the effective working of the Sale of Food and Drugs Acts necessarily obstructed.

“Apart from the question of the desirability of combining these medical and analytical appointments, it is doubtful whether such combined appointments are strictly legal. In any event, it cannot be said that they were contemplated when the Act was passed, as may be inferred from the following extract from the Sale of Food and Drugs Act, 1875 :

38 and 39 Vict., Chap. 63.

“‘13. Any medical officer of health, inspector of nuisances, or inspector of weights and measures, or any inspector of a market or any police constable under the direction and at the cost of the local authority appointing such officer, inspector, or constable, charged with the execution of this Act, may procure any sample of food or drugs, and if he suspect the same to have been sold to him contrary to any provision of this Act, shall submit the same to be analysed by the analyst of the district or place for which he acts, or if there be no such analyst then acting for such place, to the analyst of another place; and such analyst shall, upon receiving payment as is provided in the last section, with all convenient speed analyse the same, and give a certificate to such officer, wherein he shall specify the result of his analysis.’

“While the section above quoted clearly indicates that the Medical Officer of Health and Public Analyst should be two distinct persons, it provides an additional reason why the Medical Officer of Health of a district should not be the Public Analyst of the same district, for it states that the medical officer is one of the persons whose duty it may be to take samples for analysis, or to procure their being

taken. It must be admitted that it is inadvisable that the person who procures samples, thus suspecting them to be sold contrary to the Act, should also be the person to whom they are entrusted for analysis.

"In connection with the appointment of a Medical Officer of Health, the Local Government Board have the advantage of the advice of the medical officer to the Board. But in connection with the appointment of Public Analyst—which is not a medical appointment, and can only rightly belong to the profession of analytical and consulting chemistry—there does not appear to be attached to the Board any officer who is technically conversant with the qualifications necessary for the proper conduct of the practice of an analytical and consulting chemist.

"In reply to the Council's representations, a letter was received from the Board stating that, although they have not encouraged the holding of the two offices of Medical Officer of Health and Public Analyst by the same person, they were not prepared to lay down a general rule that the two offices should not be held together. Although the Board in their reply have not dealt with all of the points raised, the Council has reason to believe that their action has been beneficial."

REVIEWS.

SELECT METHODS IN FOOD ANALYSIS. By HENRY LEFFMANN, A.M., M.D., and WILLIAM BEAM, A.M., M.D. Published by P. Blakiston, Son, and Co., 1,012, Walnut Street, Philadelphia. Price \$2.50.

In the preface to this work it is pointed out that the book "is intended to be a concise summary of analytic methods adapted to the needs of both practising analysts and advanced students in applied chemistry." The work certainly justifies such a description. Considerable pains have been taken, particularly in avoiding unnecessary detail, to prominently bring forward such points as are essential, and in describing such principles as are involved in general commercial food analysis.

The opening chapters of the book deal with physical data, and subsequently with chemical data. On carefully reading the first twenty-six pages, into which is compressed the physical portion, one feels somewhat disappointed that it does not occupy a larger number of pages—not because the descriptions and methods are exactly curtailed, but because the information is so rarely given in such a concise form.

The second portion of the book is devoted to applied analysis. Interesting information is given on poisonous metals, colours, and preservatives, and interest attaches to the information with regard to preservatives, because the practices maintaining in this country for preserving articles of food are not necessarily the same as those in America. The articles on starch, sugar, fats, and oils are all indicative of the pains which have been taken to introduce, as far as possible, all the essential data which one requires without the unnecessary information which one so frequently finds in books of reference.

The remainder of the work covers the important ground of milk and milk

products, non-alcoholic beverages, condiments and spices, alcoholic beverages and flesh foods. Fifty-eight pages are devoted to milk and milk products, and the information therein contained is thoroughly up-to-date.

Altogether the work gives one the impression of being somewhat condensed, but entirely satisfactory, and will certainly form a valuable addition to the shelves of the analyst.

We should have wished to see mention made of the Marsh test for arsenic, which for so long, in some modification or other, has held its own against all other methods of detection.

A small number of mistakes occur which have obviously crept in through oversight. For example, on p. 23 we find Fig. 12 described as "Fig. 23"; on p. 36 the word "grains" is rather awkwardly substituted for "grammes"; and on p. 167 a more serious error occurs, where the specific gravity of butter-fat is given as 0.909 to 0.914, and that of cocoanut olein as 0.907 at 100°. This obviously refers to 100° F., although the corresponding figures given for other fats are obviously intended for 100° C. The type of the book is excellent, and the illustrations equally satisfactory.

W. C.

THE CHEMICAL ESSAYS OF CHARLES WILLIAM SCHEELLE. Translated by THOMAS BEDDOES. (London: Scott, Greenwood, and Co.) Price 5s. net.

The bulk of this book consists of a new edition of the original translation of Scheele's twenty-five Essays by Beddoes, which appeared in 1786, and to these is now added a short biography of the great chemist by J. Geddes M'Intosh. The essays are in reality the notes of the experiments made by Scheele during his all too brief, but brilliant career. Couched in simple and terse language, they bear upon them the impress of a highly conscientious mind humbly seeking the truth, and adding fact to fact until a safe deduction could be made. When one bears in mind the difficulties Scheele worked under—for his circumstances were never at any time luxurious—the primitive apparatus at his command, and the enormous amount of excellent work he performed, one cannot fail to be struck with admiration at the indomitable perseverance of the man against all obstacles. The book is one which will be read with satisfaction by all true students of science.

W. J. S.

INSTITUTE OF CHEMISTRY.

WE are informed that the next examinations will be held at the Institute in January, 1902. The intermediate examination will occupy at least four days, commencing on Tuesday, January 7. Examinations in the following branches of the final examination will extend over at least four days, and may commence on either January 7 or 14: (a) Mineral Chemistry; (b) Metallurgical Chemistry; (c) Physical Chemistry; (d) Organic Chemistry; and (e) The Analysis of Foods and Drugs and of Water, including an Examination in Therapeutics, Pharmacology, and Microscopy. An Examination in Therapeutics, Pharmacology, and Microscopy (open to Fellows and Associates) will also be held in January next.

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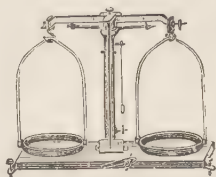
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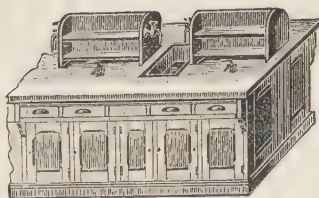
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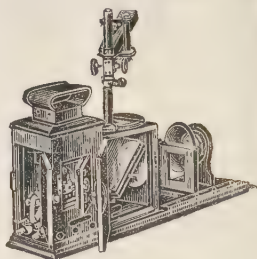
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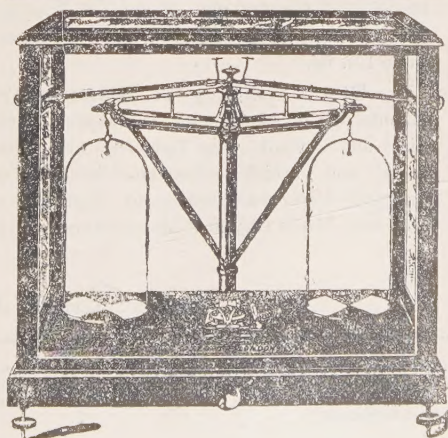
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